


# Water Solutes

## Setting up fluid system rheology

# Water Solutes, No information – No Problem

**Step 1: Set up a water solute in the table. This is the additive to a fluid mixture to create viscosity.**

WATER SOLUTES ?  

	Name ?	Type ?	Molar mass ?	Viscosity multiplier per 0.001 mass fraction ?	Power law exponent - n ?	Strain rate for transition to zero-shear rate plateau [s <sup>-1</sup> ] ?	Viscosity multiplier per 0.001 mass fraction (in the well) ?	Friction adjustment factor ?	
1	FR	Modified Power Law ▾	1000000	10000	0.6	1		0.8	

- **Our objective is to create a ‘typical’ HVFR fluid.**
- Name the additive.
- Specify a modified power law fluid.
- The molar mass will control the ability of the fluid to create a filter cake. A molar mass that is greater than the maximum flowing molar mass set in the static model will NOT create a filter cake. Shales have low perm and therefore low to no filter cake.
- Viscosity multiplier – we will use the wizard to set this.
- Power law exponent, strain rate and viscosity multiplier can be used if you have specific fluid testing otherwise use the defaults.
- Friction adjustment factor allows us to tune the wellbore friction so as the FR (friction reducer) is pumped the WHP should be reduced.

# Water Solutes, No information – No Problem

Step 2: Set up fluid mixture. This is the fluid that is pumped in the well controls.

FLUID MIXTURES ?

▼ HVFR

Name  
HVFR ?

VISCOSITY SUMMARY ?

	Viscosity at room temperature and 170 s <sup>-1</sup> [cp] ?	Viscosity at reservoir temperature and 170 s <sup>-1</sup> [cp] ?
1	34.2122539756707	11.7602131264237

INJECTION FLUID MIXTURE COMPOSITION ?

	Water solute ?	Unit for input ?	Input quantity ?
1	FR	gpt ▾	1

Give your fluid mixture a name.

The viscosity will be controlled by the input quantity. For example, if actual viscosity measurements were available and the input quantity was 1 gpt, then the wizard set the fluid viscosity at this concentration.

**We will use the wizard to finalize these values.**

# Water Solutes, No information – No Problem

## Step 3: Use the wizard to set up typical fluid.

### Water solutes wizard

This wizard sets the modified power law input parameters for water solutes. Prior to using this wizard, you should have already specified the water solute concentration. If the mixture had more than one water solute with nonzero concentration, it would be ambiguous how much effect each solute should have. This wizard will set a value for 'viscosity multiplier' of the underlying water solute. Also, it will set a value for 'n' and 'transition shear rate' if none have already been specified.

Is this fluid a cross-linked gel? If you specify 'yes', then this wizard will automatically create a 'broken gel' and a 'water solute reaction' for it to create.

Cross-linked gel?  ?

X-Link?

What is the name of the fluid mixture for which you would like the wizard to set up the viscosity parameters?

Fluid mixture name  ?

The name of the fluid mixture created earlier.

Do you know the fluid viscosity at a particular shear rate?

Know viscosity?  ?

Do you know the viscosity, shear rate and temperature?  
Use that or we can create a 'generic' fluid.

Next

Reset to default values

### Water solutes wizard

Because you do not know the viscosity, we will use a 'typical' value based on the fluid type. Please specify the fluid type below.

Frac fluid type  ?

Choose a fluid to approximate.

Previous

Apply

Reset to default values

Brine water

Slickwater

HVFR

Linear gel

Cross-linked gel

# Water Solutes, No information – No Problem

WATER SOLUTES ? 📊 ⚠️

	Name ?	Type ?	Molar mass ?	Viscosity multiplier per 0.001 mass fraction ?	Friction adjustment factor ?
1	FR	Modified Power Law ▾	1000000	11057.7340989205	0.8

▼ HVFR

Name HVFR ?

VISCOSITY SUMMARY ?

	Viscosity at room temperature and 170 s <sup>-1</sup> [cp] ?	Viscosity at reservoir temperature and 170 s <sup>-1</sup> [cp] ?
1	37.8189831172703	13

INJECTION FLUID MIXTURE COMPOSITION ?

	Water solute ?	Unit for input ?	Input quantity ?
1	FR	gpt ▾	1

ResFrac has adjusted the viscosity multiplier in the water solutes table to achieve a ‘typical’ HVFR fluid viscosity of 13 cP with an FR concentration of 1 gpt. Changing this value changes the viscosity accordingly. Alternatively, if you think the viscosity is lower or higher at this input quantity, the viscosity multiplier can be changed.

When an HVFR is pumped, often the WHP goes down. You can use the friction adjustment factor for this additive to help match WHP during treatment.

If necessary, multiple water solutes and fluid mixtures can be created with different friction adjustments to accommodate different concentrations of FR.

# Water Solutes – A Few Notes About X-Link Gel

Using the exact same methodology as described before, except specify a cross-linked gel in the wizard.

	Name ?	Type ?	Molar mass ?	Viscosity multiplier per 0.001 mass fraction ?	Power law exponent - n ?	Strain rate for transition to zero-shear rate plateau [s <sup>-1</sup> ] ?	Viscosity multiplier per 0.001 mass fraction (in the well) ?	Friction adjustment factor ?	
1	FR	Modified Power Law ▾	1000000	11057.7340989204	0.6	1		0.8	☰
2	X-Link Additive	Modified Power Law ▾	1000000	255914.08228278	0.6	1	2526.1540228278		☰
3	X-Link Additive_degraded	Inert Solute ▾	1000000						☰

This time ResFrac has specified two viscosity multipliers. The one on the left specifies the X-linked viscosity in the fracture and the one on the right specifies the viscosity of the fluid as it is being pumped in the well.

Finally, ResFrac has specified an inert solute that the X-link breaks into. Specify the time at which the X-link breaks.

Name: X-Link Gel ?

VISCOSITY SUMMARY ?

	Viscosity at room temperature and 170 s <sup>-1</sup> [cp] ?	Viscosity at reservoir temperature and 170 s <sup>-1</sup> [cp] ?
1	872.745764244699	300

Name: X-Link Gel ?

VISCOSITY SUMMARY ?

	Viscosity at room temperature and 170 s <sup>-1</sup> [cp] ?	Viscosity at reservoir temperature and 170 s <sup>-1</sup> [cp] ?
1	8.727457642447	3

## REACTIONS BETWEEN WATER SOLUTES [1/HOURS] ?

	Reactant ?	Product ?	First-order reaction constant [1/hours] ?	
1	X-Link Additive ▾	X-Link Additive_degraded ▾	0.666666666666667	☰



# Thank You!

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